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JASPER-HINTON AIRPORT PLANNING STUDY

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JASPER-HINTON AIRPORT
PLANNING STUDY

Submitted to:

ALBERTA TRANSPORTATION AND UTILITIES

Prepared by

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PROJECT: 22784

FEBRUARY 26, 1990

Reid
Crowther

Please refer to file 22784-4(a)

February 27, 1990

Alberta Transportation and Utilities
Twin Atria Building,
4999 - 98th Avenue
Edmonton, Alberta T6B 2X3

Attention: Linda Penrose
Policy Analyst

Dear Ms. Penrose:

Re: Jasper-Hinton Airport Planning Study

We are pleased to provide herewith our final report concerning possible facility upgrading at the Jasper-Hinton Airport. The report can be submitted under the Local/Local Commercial Airports Program.

It has been a pleasure to work with the Steering Committee on this project. We sincerely appreciate the assistance provided by everyone concerned with this study.

Yours truly,

REID CROWTHER & PARTNERS LTD.

Harvey E. Olsen.

H.E. Olsen, P.Eng.
Transportation Division, Manager

Encls.

HEO:sj

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EXECUTIVE SUMMARY

The Jasper/Hinton Airport was constructed in the mid 1970's in response to predicted air traffic originating from local business interests, tourism and private aircraft owners. Economic conditions of the mid 1980's have renewed interest in the airport from both the scheduled service and tourism sectors. This report addresses the potential upgrading projects which could be undertaken to enhance airport services to attract scheduled and charter services.

The existing airport airside has a 4500 foot paved runway, with associated taxiways, aprons, hangar, navaids and tie-down area. An aircraft refuelling operation has recently been installed adjacent to the apron. The terminal building accommodates the air operations of Jaspair, a licensed operator providing charter tours with Jasper/Hinton Airport as its base. The landside consists of a gravel access road, gravel parking lot and maintenance garage.

A 1988 report commissioned by Alberta Tourism concludes that the Jasper/Hinton Airport has a function as a gateway airport using DASH 7 and DASH 8 style aircraft to Edmonton and Calgary International Airports. The DASH 7 and DASH 8 service is predicted to operate as a connecting service primarily supporting the areas seasonal influx of tourists.

A review of the existing airport infrastructure identified a number of projects which would enhance the airport for scheduled connector service and for itinerant aircraft and for itinerant aircraft.

Recommended airside upgrading includes aircraft plug-ins for the tie-down area at an estimated cost of $15,000.

The terminal building is capable of accommodating approximately 20 peak design hour passengers arriving and departing, who must be ticketted

and have access to waiting areas. Design aircraft passenger loads of up to 50 can be accommodated if routine terminal functions such as ticketting and baggage handling are done remote from the terminal for tourist groups. The implementation of a scheduled ground transportation link has been recommended in previous reports. This bus service is ideal for remote ticketting and baggage handling. A nominal increase in the terminal building area is recommended to allow provision of basic passenger services such as vending machines, a baggage handling area and the potential for provision of other passenger services as the need arises. The estimated cost of terminal expansion is $170,000.

The landside consists primarily of the gravel access road and parking lot. A significant enhancement to the airport infrastructure and the attractiveness of the groundside transportation link would be the paving of these two facilities. The ground transportation link recommended by the air service development study would benefit significantly from the paving program. The perception of the airport as a domestic and internationally acceptable air-to-ground transfer point would be enhanced by the provision of paved roads and parking. The safety of the roadway, due to the reduced dust emission, would be enhanced by the paving program.

The estimated cost of the paving the access road and the parking lot is $825,000.

The potential to extend the runway at both ends was investigated, and it was determined to be feasible from an engineering perspective to construct the runway extension in either direction. The southwest extension of the runway is less desirable than the northeast extension. The southwest extension requires larger quantities of fill and there are conflicts with both the precision obstacle approach zoning and missed approach zoning. An extension of up to 1000' to the northeast is feasible if the trees projecting above the top of a nearby hill are removed. Further extensions of the runway as a precision or non-

precision runway are feasible but a hill lying northeast on the runway centreline must be lowered. This is achievable as the runway extension will require large quantities of fill.

Bedrock blasting and the 3 to 4 kilometer haul distance make runway extension an expensive option.

Runway requirements and costs are summarized in Table 1. Air terminals to accommodate design volumes up to 100 passengers are estimated to cost between $1,100,000 and $1,375,000. Other airside and landside upgrading would also be required to support the runway lengths.

The order of importance of these projects to the Jasper/Hinton Airport is:

1.	Paving program for the access road and parking lot.	$825,000
2.	Tie-down area aircraft plug-ins.	$15,000
3.	Terminal expansion.	$170,000

TABLE 1:

RUNWAY REQUIREMENTS AND COSTS (CURRENT RUNWAY = 4,500 FEET)

Type of Plan (# of Passengers)	Total Runway Required	Estimated Cost of Runway Extension to:[+]
Dash 7 (50 - 54 passengers)	Current runway adequate	Nil
Dash 8 (37 - 40 passengers)	Current runway adequate	Nil
Boeing 737 (118 passengers)	6,000 feet for a stage length of 500 miles (flights to Edmonton or Calgary)*	6,000 feet - $12,000,000
Boeing 727 (145 passengers)	8,000 feet for a stage length of 500 miles (flights to Edmonton or Calgary)*	8,000 feet - $18,500,000
Boeing 737 (118 passengers)	10,000 feet for a stage length of 1,800 miles*	10,000 feet - $46,000,000
Boeing 727 (145 passengers)	12,000 feet for a stage length of 1,800 miles*	12,000 feet - $50,000,000

[+] The estimated cost of the runway extensions includes parallel taxiway and apron improvements.

* The runway would also require widening to 150 feet from the current 100 feet runway. Runways of these lengths are normally associated with parallel taxiways, larger aircraft aprons and terminal buildings.

CHAPTER 1

INTRODUCTION

INTRODUCTION

The Jasper-Hinton Airport was constructed in the mid 1970's to meet local area aviation needs related to commercial and private aircraft. The aviation needs of the local commercial/business enterprises, private aircraft owners and the tourism industry have been identified and summarized in previous studies. The predicted air traffic volumes as a result of the Jasper/Hinton Air Service Development Study (1) (hereinafter called the Air Service Study) necessitates this study be conducted to confirm the feasibility of certain options and to provide cost estimates for planning purposes.

STUDY OBJECTIVES

The study objective is to undertake a planning review of the Jasper-Hinton Airport infrastructure. The review is intended to identify infrastructure upgrading projects which will enhance the airport's attractiveness as a scheduled flight and charter destination. The design aircraft is to be capable of accomodating 50 to 70 passengers. The identified upgrading projects are to have construction costs estimated. This objective was achieved through the following tasks:

- site visit and discussions with local area businessmen, administrations and airport staff;
- identification of new facility requirements, improvements and expansions required to accommodate passenger projections;

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(1) Jasper-Hinton Air Service Develoment Study, Report for Alberta Tourism by IMC Consulting Group Inc., February 1988.

- feasibility study to ensure compliance with established guidelines;
- cost estimating of feasible options;
- priorizing of feasible options.

The completion of these tasks lead to the recommendations documented in this report.

REPORT

This report documents the existing airport facilities, the airport development plan outline, the proposed projects, the project need and provides estimated funding requirements. This report employs the recommendations of the Air Service Study to evaluate options and make recommendations regarding upgrading projects.

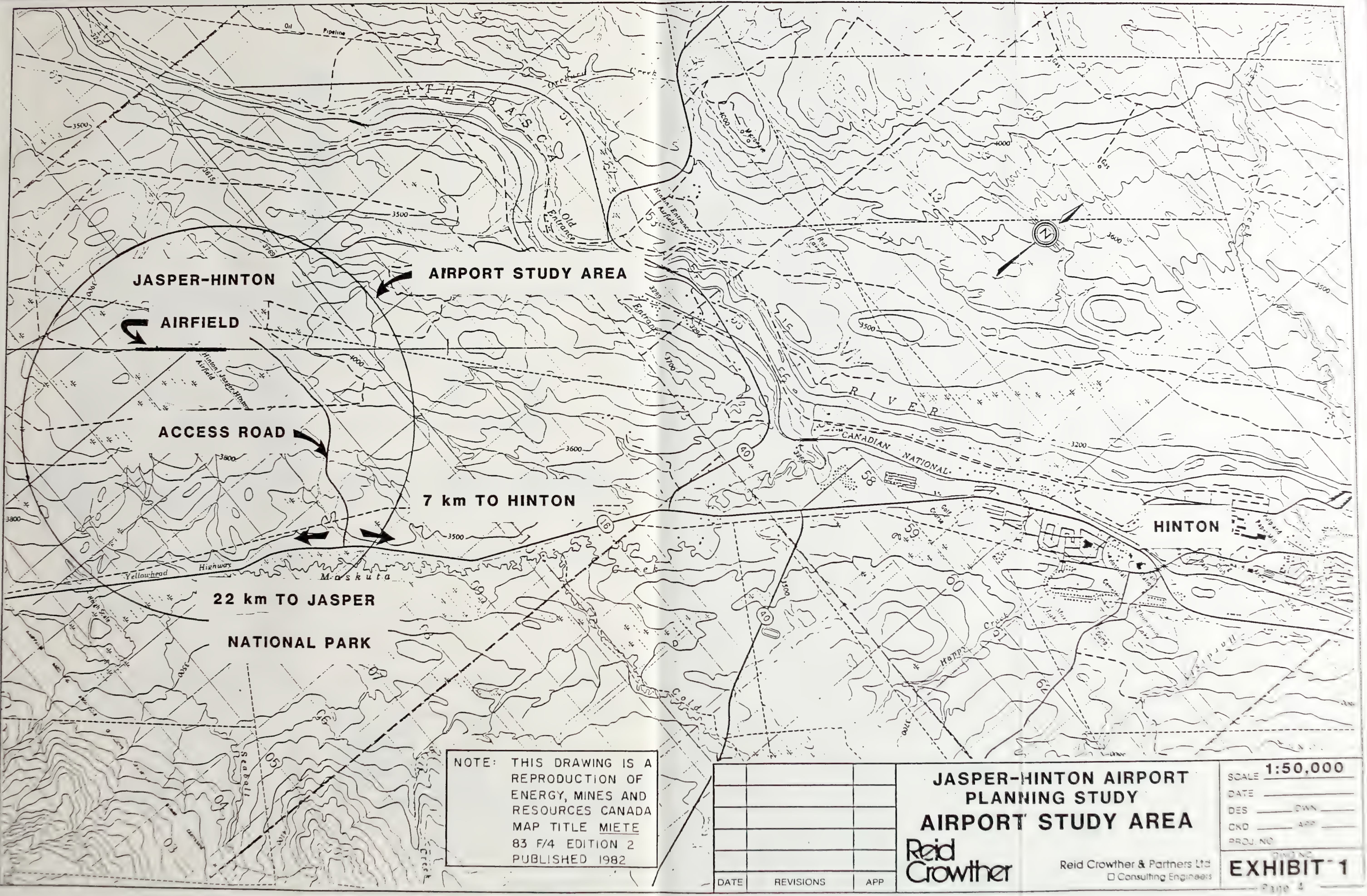
CHAPTER 2
THE EXISTING AIRPORT

THE EXISTING AIRPORT

The existing airport is a Code 3 day/night VFR airport Certified (licensed) by Transport Canada. The location of the airport is approximately 14 kilometers southwest of Hinton, Alberta. The location of the Jasper/ Hinton Airport and the surrounding locale is presented in Exhibit 1. The airport is also approximately 27 kilometers north east of the Jasper National Park east entrance gate. A smaller grass airfield, Hinton Entrance, lies 7.5 kilometers to the northeast of the Jasper/ Hinton Airport. The existing airport is described in the following sections beginning with the airside, then the terminal and concluding with the landside.

AIRSIDE

The main runway, 20-02 orientation, is a 100 foot (30.48 m) wide 4,500 foot (1,371.6 m) long paved runway. Local terrain constraints require displaced thresholds at both ends of the runway. A displacement of 200 feet (60.96 m) exists at the 02 threshold. A displacement of 300 feet (91.44 m) exists at the 20 threshold. There is a 250 foot (76.2 m) graded area on each side of the centerline of the runway. The airport layout is presented in Exhibit 2. Typical sections are presented on Exhibit 3. There are both paved and grass taxiways which are 50 feet (15.24 m) wide with 50 foot (15.24 m) graded areas on both sides. The paved aircraft apron is 200 feet by 300 feet (60.96 m x 91.44 m) with two aircraft plug-in spots and a refuelling location. A total of 8 aircraft grassed tie-down positions are available along 2 cables north of the apron. One aircraft hangar has been constructed adjacent to the taxiway. The airport is fenced from the adjoining lands.



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AIRPORT STUDY AREA

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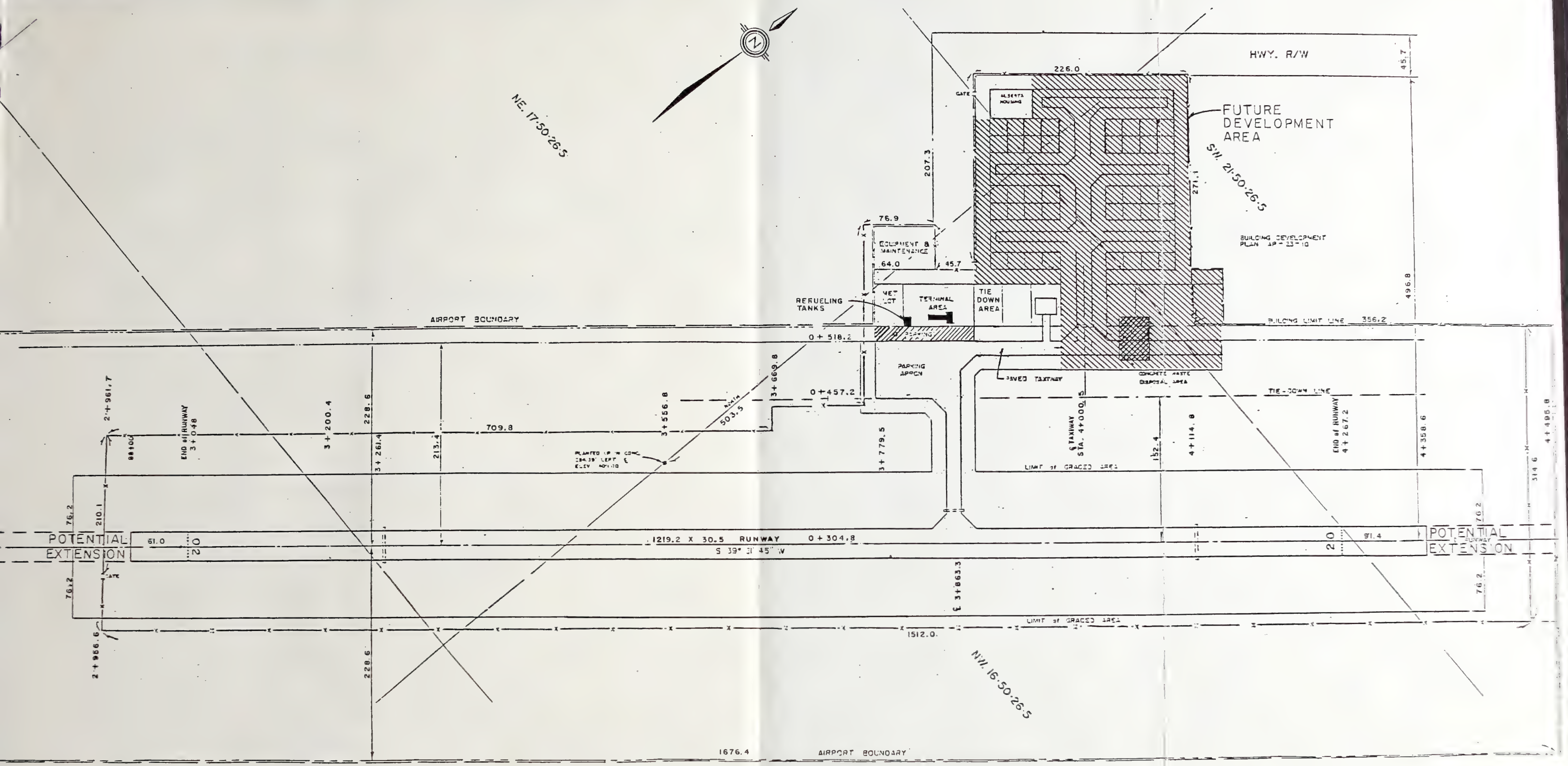

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JASPER-HINTON AIRPORT PLANNING STUDY

EXISTING AIRPORT

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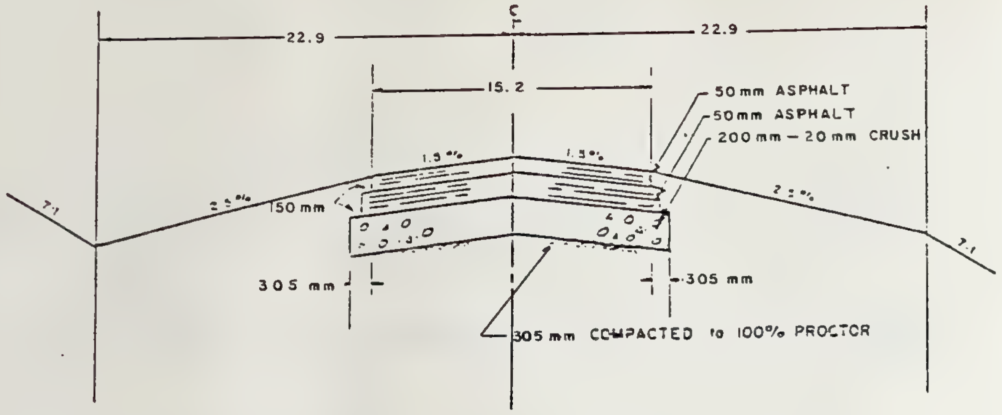

TYPICAL TAXIWAY SECTION
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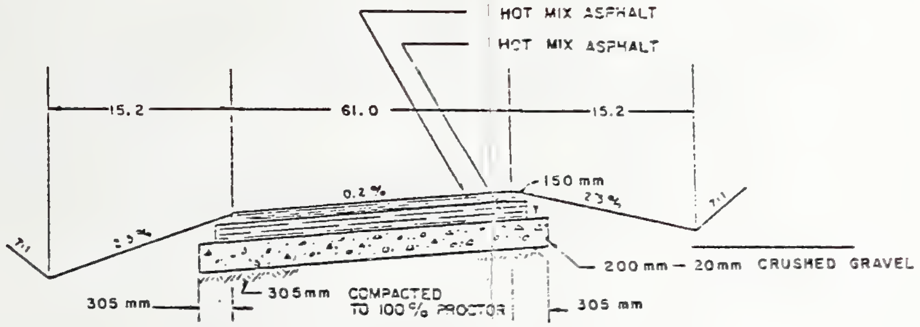

TYPICAL PARKING APRON
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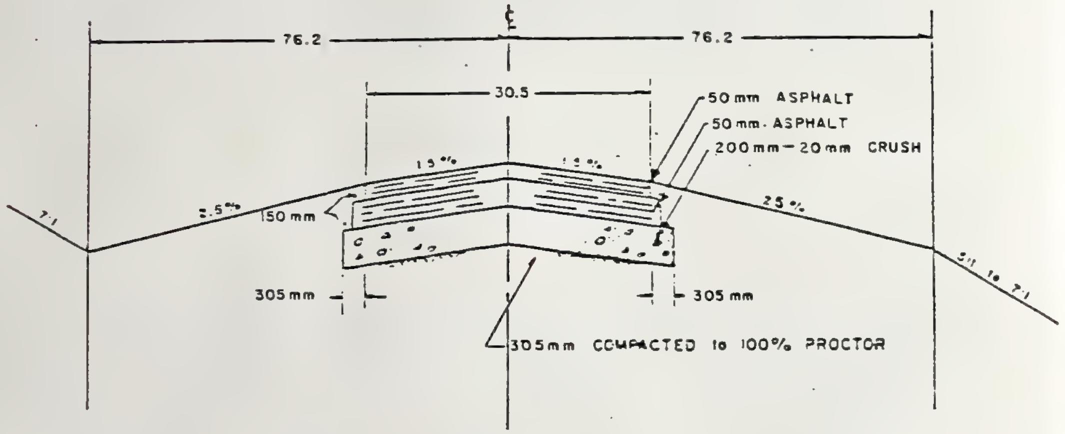

TYPICAL RUNWAY SECTION
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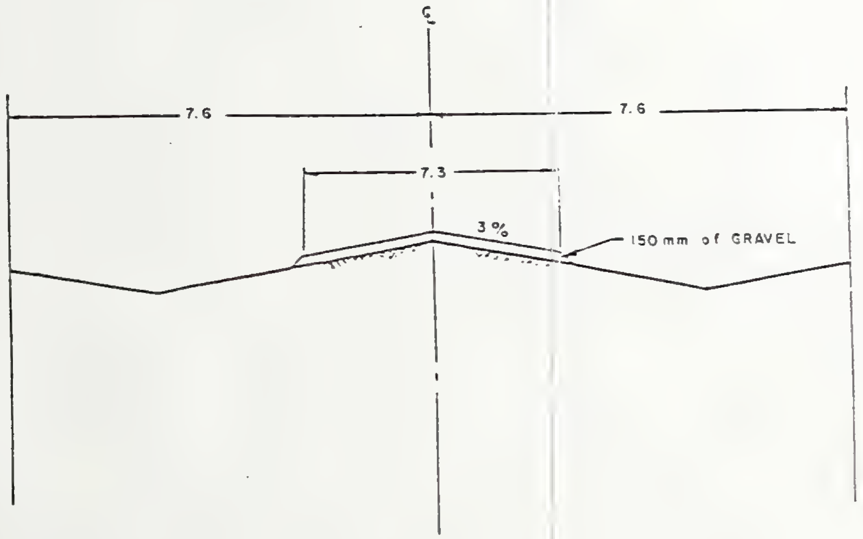

TYPICAL ACCESS ROAD SECTION
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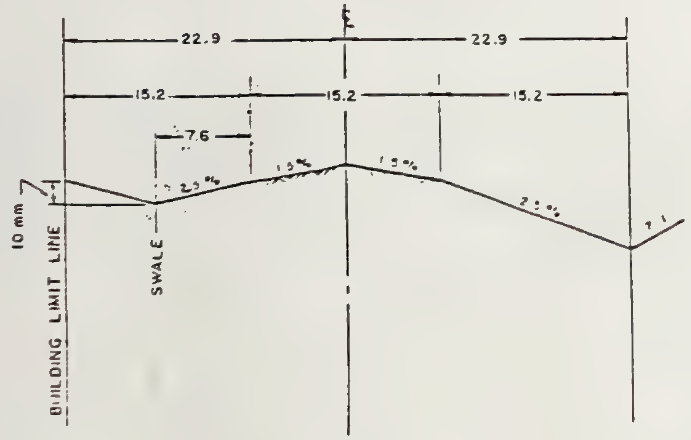

TYPICAL GRASS TAXIWAY SECTION
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TYPICAL SECTIONS

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The airside is maintained by local airport staff. Grass mowing and snow removal are among the routine maintenance operations.

The instrument flight rule (IFR) approaches are approved for "company use".

The runway is equipped with medium intensity lights, VASIS and a Microwave Landing System (MLS). The taxiways and apron are lighted. Other navigational aids include windsocks, and a Type I Automated Weather Observation and Reporting System (AWOS), Non Directional Beacon (NDB) and Distance Measuring Equipment (DME) are operational and there is an Aircraft Radio Control of Aerodrome Lighting (ARCAL) system for runway lighting control.

TERMINAL

The terminal is a prefabricated modular type with 1,660 sq. feet (161.7 sq. m) of space. Table 1 presents Transport Canada's Systemized Terminal Expansion Program (STEP) areas for various sized terminals. The Transport Canada terminal areas are guidelines for planning purposes. For comparison purposes, the existing Jasper/Hinton Terminal areas are provided. Given a peak hour passenger design volume of 50 to 70 passengers a STEP 3 or STEP 3.5 category terminal would be appropriate.

Water supply is provided through on-site wells and a pressure pumping system. Sewage disposal is provided by a buried cistern which is pumped on an as required basis. Electricity is provided by overhead power line to the site.

TABLE 2 - TERMINAL SPACE STANDARD COMPARISONS (m^2)

Terminal Area Requirements	Step 3	Step 3.5	Step 4 Step 3X	Jasper/Hinton Existing
PUBLIC AREAS				
Ticketing	--	--	--	--
General Waiting	113	151	182	131.7
Holdroom	--	--	32	--
Baggage Claim	--	--	--	--
Bag Claim Devices	5	7	10	--
Washrooms	27	27	35	25
AIRLINE OPERATIONS AREA				
Ticket Counters	8	15	19	4.0
Offices	20	27	40	12.3
Common Use Bag Areas	32	43	71	--
CONCESSIONS & PAX SERVICES				
Telephones	1	2	2	1
Lockers	1	1	1	--
Car Rentals	4	4	8	--
Vending Machines	3	3	3	--
Food & Beverage Services	--	--	--	--
Gift Shop/Newsstand	--	--	--	--
SECURITY				
Airport	--	--	--	--
Passenger - Check Point	--	--	10	--
- Office	--	--	--	--
ADMINISTRATION				
Airport Manager	18	15	15	13.7
General Office	--	12	12	--
Lunch/Training/Meeting Room	--	--	15	--
Manager Operations	--	--	--	--
Manager Admin. & Finance	--	--	13	--
* Emergency Coord. Centre	--	3	5	--
Sub-Total	232	310	473	161.7
BUILDING SERVICES & EQUIPMENT				
10% Allowance	23	31	47	
Sub-total	255	341	520	
CIRCULATION & STRUCTURE				
28% Allowance	71	188	145	--
TOTAL	**326**	**436**	**665**	**161.7**

Notes: 1. *ECC shall be accommodated in APM office or meeting room.
2. Guideline based on average demand.
3. All values in square metres.

LANDSIDE

The main access road is five kilometers long and leads from Highway 16, (Yellowhead Highway), directly to the airport site. It is a single purpose gravelled road constructed to Alberta Transportation rural road standards. A typical section is presented on Exhibit 3. A gravelled parking lot exists between the maintenance garage and the terminal building.

Five plug-ins for cars have been installed for staff and visitor use along one edge of the lot. The gravelled lot also provides manoeuvering area for maintenance equipment at the maintenance garage. Vehicle access to the tie-down area and the hangar is also available.

CHAPTER 3
AIRPORT DEVELOPMENT

AIRPORT DEVELOPMENT

The role of the Jasper-Hinton Airport is to enhance the opportunity for private, business and tourism related air travel in the Jasper-Hinton area. This is accomplished by the provision of a high quality airfield, well-equipped to handle commercial and general aviation flights with day and night operations under both VFR and IFR operating conditions.

The long term future expansion of the Jasper-Hinton airport is uncertain at this time. The Air Service Study explored the possibility of service in the future by aircraft larger than 100 passenger capacity. This type of service would require significant upgrading of the airport including runway extension, parallel taxiway construction, apron expansion, air terminal expansion and landside facility expansion.

In the short term, the design aircraft to be accommodated at the airport are commercial passenger aircraft up to 50 to 70 capacity. This passenger carrying volume indicates aircraft of DASH 7 and DASH 8 type.

The Air Service Development Study identified tourism as the major potential market for air traffic. Approximately 96% (2) of all potential air trips to and from the Jasper/Hinton area would be tourism related. The report identifies connector service as the most probable air service serving as a gateway to Edmonton and Calgary. The connector services would initially be a seasonal service related to the tourist seasons. The report identifies a four step incremental growth approach to establishing air service. The four steps include

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(2) Reference (1) page 24

establishing a scheduled ground link, establishing a regional connector service to area airports, enhancing the regional connector service with direct air service to passenger origin/destination points and ultimately direct market air service.

In undertaking a review of the airport infrastructure two points are significant to the project identification process. First, it is recognized that tourism will likely be the initial and most significant long term generator of air traffic to the Jasper-Hinton area. Second, the requirement to establish a ground transportation service link to the local tourist areas invariably will require infrastructure to support highway bus usage. A local bus company has expressed on interest in providing this service. Their letter appears as Appendix A of this report.

The following area reviews are directed towards increasing the airport's attractiveness to tourist charter operators, touring private aircraft enthusiasts, and ground transportation services (bus) operators.

AIRSIDE REVIEW

The runway, taxiway and apron sizing are sufficient to accommodate DASH 7 and DASH 8 as the design aircraft. The existing navigational aids are sufficient to accommodate the requirements of most aircraft and schedules. The introduction of an Instrument Landing System (ILS) would assist those aircraft not equipped with Microwave Landing System (MLS) equipment. The runway is to be checked for feasibility of extension at this time, as there is little documented requirement for more than the 4,500 feet of runway available today. The runway extension possibilities are presented in Chapter 4. Minimal airside infrastructure upgrading is required at this time. Upgrading of aircraft parking and over-nighting facilities would enhance the airport as an itinerant aircraft destination.

TERMINAL BUILDING REVIEW

In reviewing the existing air terminal, two passenger types should be considered. First the local passenger flying to or from the airport. This passenger requires complete terminal facilities both arriving and departing. Second, tourist passengers who will be met by the bus and returned by the bus. It is likely that ticketting and luggage handling for these individuals can be accommodated by the bus line operator. This would reduce the terminal requirements for these passengers to a minimum as they would require only a flow-through facility.

The sizing of the terminal is established through the development of the airport passenger peak design volume (PDV). The peak design volume is considered to be the highest passenger volume to be accommodated over a one-half hour time span. In the case of Jasper/Hinton Airport and using DASH 8 - 300 as the design aircraft there could be 54 passengers arriving and departing. Rather than sizing the terminal to accommodate the full DASH 8 passenger load, given the passenger type split, it is more appropriate to establish the passenger accommodation volume of the existing structure. Since the existing terminal is smaller than a STEP 3 average terminal, small terminal criteria have been used to estimate space requirements.

Small Terminal Type I (SMI)

Area requirements = [(Enplaned PDV + Enplaned PDV x meeter/greeter ratio) + (Deplaned PDV + Deplaned PDV x meeter/greeter ratio)] X 2.3 m^2

Assuming (1) Meeter/greeter ratio = 50% PDV
(2) Enplaning passengers = deplaning passengers

Existing terminal = 19 PDV at 131.7 m^2 of passenger related space.

Therefore, 19 enplanning and 19 deplanning passengers can be accommodated by the existing terminal. For the DASH 8-300 passenger scenario, up to 19 local passengers plus 35 tourists ticketted remotely the ground transportation link could be accommodated. Fewer local passengers can be expected if up to 96% (3) all air traffic is tourist related.

This calculation does not include areas for security checks, passenger services or a sterile holding room. Also ground link passengers are allowed to "file through" the terminal only and complete any waiting periods on the bus or on the aircraft.

Terminal expansion should be considered as an infrastructure upgrading project, security checks are mandatory in most airports today. Certain flights, such as Calgary destined flights from Lethbridge, do not currently require security checks because passengers must clear security in Calgary prior to proceeding on another aircraft. A similar situation can be established for Hinton/Jasper, but it is likely to be a short term condition. Similarly, passenger services such as U-drives, and at a minimum, vending machines will be required in place of a concessions stand. Terminal area will be required for these purposes.

LANDSIDE REVIEW

The landside access road and parking lot are gravelled. These facilities will be used by private vehicles, cars and trucks, and buses for the proposed ground transportation link. Since the volume of tourists is expected to be a large proportion of the air travellers, an abnormally high percentage of the airport destined traffic will be buses in the traffic stream. The existing gravel road and parking lot will be more difficult to maintain than a paved surface given the large

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(3) Reference (1) page 24

proportion of buses. Paving the access road and parking lot will also increase road safety by reducing dust. Long term bus maintenance costs will be reduced by the provision of a paved route, hence reducing transportation costs. It is also worthy of note that a majority of the predicted tourists are travelling internationally and their perception of the area will be important to their subsequent recommendations to other perspective tourists and to their own plans to return.

For scheduled air service assuming 19 enplaning and 19 deplaning passengers and an occupancy ratio of 1 passenger per vehicle, 38 stalls would be required. Employee parking should be established at a minimum of 5 assuming airport maintenance staff park by the maintenance garage and are not included as terminal staff.

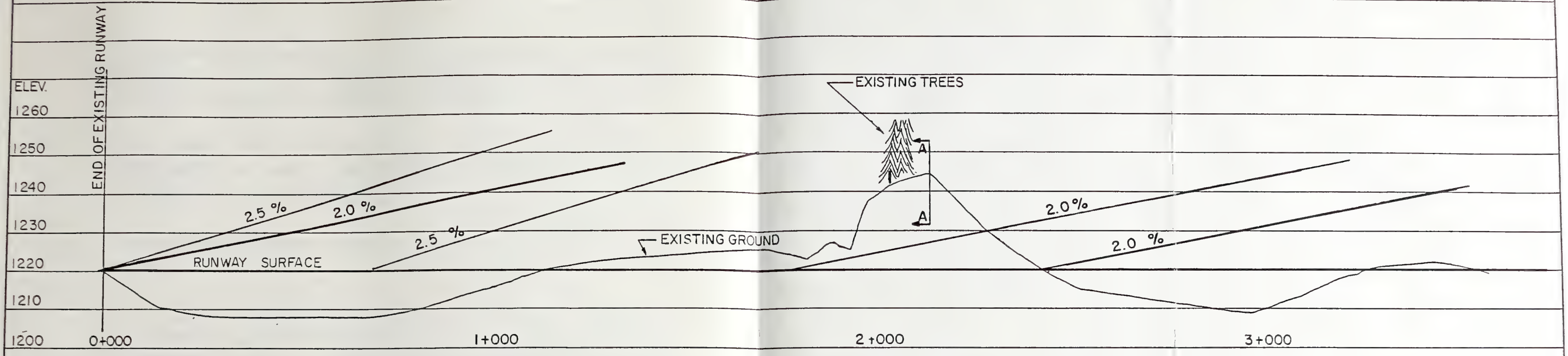
CHAPTER 4
RUNWAY EXTENSION

RUNWAY EXTENSION

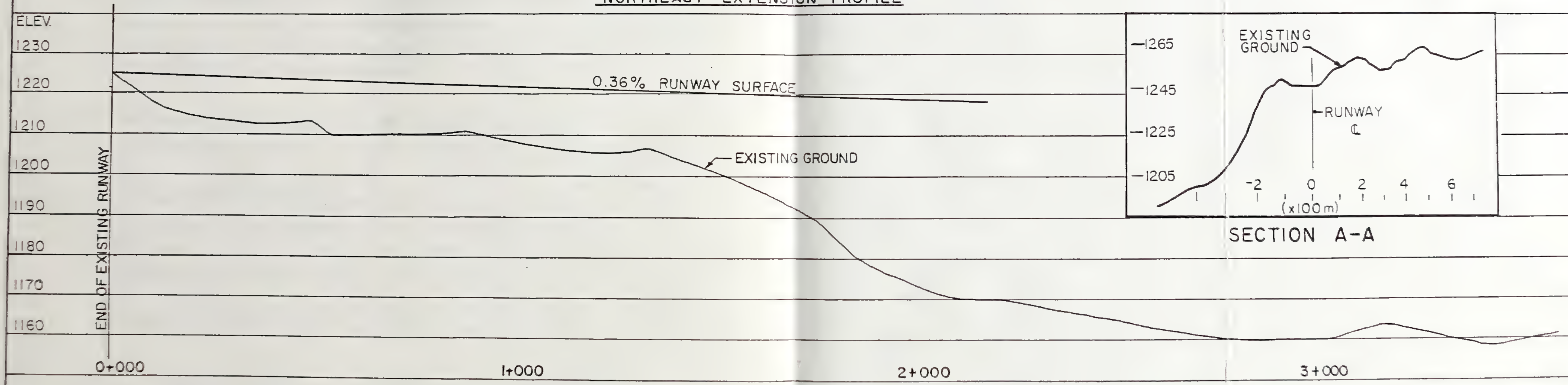
The Air Service Development Study identifies the long term planning need to accommodate aircraft carrying more than 100 passengers. Boeing 737 (118 passengers) and 727 (145 passengers) have been calculated to require runway extensions to 10,000' and over 12,000' respectively for a stage length of 1800 miles. For an interim stage length of 500 miles a runway extension to 6000' for 737's and 8000' for 727's would be sufficient. These lengths would meet requirements for flights to Calgary or Edmonton. The estimated cost of these two runway extension scenarios is developed using data obtained from aerial photography. The obstacle zoning requirements for non-precision (2.5% approach slope) and precision (2% approach slope) have been shown on Exhibit 4. The southwestern extension of the runway has been calculated for earthworks quantities. This extension is not recommended due to "missed approach" criteria conflicts with the ridge to the west and obstacle zoning conflicts for the precision approach from the south west. The runway extension to the north east requires the removal of a "hill" which is directly in the line of extension. Zoning requirements have been used to calculate the "hill top" elevations under the various runway extension scenarios.

Thurber Consultants Ltd. were requested to undertake a preliminary geotechnical evaluation of the northeast extension of the runway. The Thurber report is presented in Appendix B of this report. The report indicates that while fills will be high and preconstruction prior to paving is recommended the runway extension is feasible.

The projected centreline profile of the existing runway was obtained by mapping aerial photography of the area. The centreline projection is presented in Exhibit 4. The hill on centerline to the northeast of the



NORTHEAST EXTENSION PROFILE



SECTION A-A

SOUTHWEST EXTENSION PROFILE

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RUNWAY AND EXTENSION PROFILES

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EXHIBIT 4

airport was also mapped on a 100 m grid to allow obstacle surface glide path calculations and to determine tree heights. The top of ridge profile and average tree heights are also presented on Exhibit 4.

The southwest runway extension quantities were calculated from a 0.36% downgrade of the runway. The northeast runway extension quantities were calculated from a 0.0% grade.

The quantities calculated for each extension are presented in Tables 3 and 4.

For a runway extension to 6000' or 8000' i.e. runway extensions of 1500' (500 m) and 3500' (1200 m) the quantity of material required to construct the runway exceeds that available if the hill top is used as the only borrow source. The runway extension to allow 737's and 727's into Jasper-Hinton would also require the upgrading of the existing pavement. The runway would require widening to 150'. Runways of this length are also normally associated with parallel taxiways, larger aircraft aprons and terminal buildings.

The ultimate extension to 12,000' requires the removal of the hill. This extension would also require adopting an international airport standard of runway and taxiway construction. To accommodate the passenger traffic accommodated by the runway extension, a STEP 4 terminal would be acceptable for a 100 passenger peak design volume. Subsequently, a STEP 4.5 passenger terminal would be adequate for a 150 passenger peak design volume. These terminals are 665 m^2 and 850 m^2 respectively. The estimated cost of the runway extensions, excluding the parallel taxiway and apron improvements are as follows:

Extension to 6000'	Runway	$12,000,000
Extension to 8000'	Runway	$18,500,000
Extension to 10,000'	Runway	$46,000,000
Extension to 12,000'	Runway	$50,000,000

TABLE 3 - APPROXIMATE EARTHWORKS VOLUME - SOUTHWEST RUNWAY EXTENSION

Length of Extension (m)	100	200	300	400	500	600	700	800	900	1000
Earthworks Volume (m^3 x 1000)	60	240	510	820	1105	1420	1800	2100	2500	2780

TABLE 4 - APPROXIMATE EARTHWORK VOLUME - NORTHEAST RUNWAY EXTENSION

Length of Extension (m)	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600
Earthworks Volume (m^3 x 1000)	45	152	302	481	678	912	1180	1442	1640	1763	1823	1843	1855	1867	1875	1878

A STEP 4.0 terminal is estimated to cost $1,100,000 and a STEP 4.5 terminal is estimated to cost $1,375,000.

Details of these estimates are included in Appendix C.

It is possible to extend the runway up to 1000' (350 m) northeast by removing all the trees projecting above the hilltop. This extension is not considered warranted unless a specific aircraft proposed for use at the Jasper/Hinton Airport requires the extension.

CHAPTER 5
PROPOSED PROJECTS

PROPOSED PROJECTS

The proposed projects outlined and costed in this chapter are taken from discussions with local flyers and others interested in the Jasper/Hinton Airport upgrading. The recommended projects are those that will enhance the airport to fulfill its role in the local Jasper/Hinton area of Alberta. Detailed estimates for the recommended projects are presented in Appendix C.

AIRSIDE UPGRADING

The addition of an instrument landing system (ILS) was requested. The airport currently has one threshold served by MLS. An ILS is not recommended for this airport as the topography severally limits the use of the system.

The development of an airside campground was suggested. While this suggestion has merit at many small airports, the wind conditions and location of the Jasper/Hinton Airport are considered negative factors in considering this upgrading option.

There is sufficient area for this to develop north of the existing tie-down area. If the need for airside camping does develop at this airport then this option can be re-evaluated.

The addition of plug-ins in the aircraft tie-down area was suggested. This is considered as an acceptable upgrading option. The airport's high elevation in the mountains leads to colder temperatures during the night than the surrounding low lands and plug-ins for aircraft would

enhance the airport as an overnighting location. The installation of light aircraft plug-ins is estimated to cost $15,000.

TERMINAL UPGRADING

The airport design aircraft is capable of carrying 50 or more passengers. Given the predicted high ratio of tourists to local pssengers it is possible to perform many of the normal airport terminal functions at a remote location for the tourist groups. The existing terminal is capable of accommodating approximately 19 peak design hour air passengers, provided security checks and baggage handling equipment are not necessary at this airport. It is recommended that the existing terminal be expanded to allow space for additional passenger related services. The terminal can be developed into a rectangular building by the addition of two modular units. This would create an additional 90 square metres of space. It would also allow the steps down to the airside doors to be relocated to the outside and the lower level entry relocated to an external wall. These two features would also increase the internal passenger space available. The additional space could be required for baggage handling, concessions by vending machine and the possible addition of a U-drive counter or a second airline counter. The estimated cost of the terminal additions is $170,000.

LANDSIDE UPGRADING

The importance of developing a ground transportation link between the Jasper/Hinton Airport and the local tourist areas has been established. This ground transportation link will be made by the bus line(s) as the needs dictate. The ground transportation link will be an important feature of the local tourism market as it will be the introduction of many foreign travellers to Canada's mountain recreational area surrounding Jasper and Hinton. The airport access road and parking lot will be these traveller's introduction to our highway and road system.

The paving of the access road and parking lot will enhance the tourists' perception of the area.

The road is recommended to be paved to a 9 m wide surface and the parking lot paved and marked to accommodate and organize bus and car parking. A parking lot layout is presented in Exhibit 5. The estimated cost of this paving program is $825,000.

AREA ENVIRONMENTAL ASSESSMENT

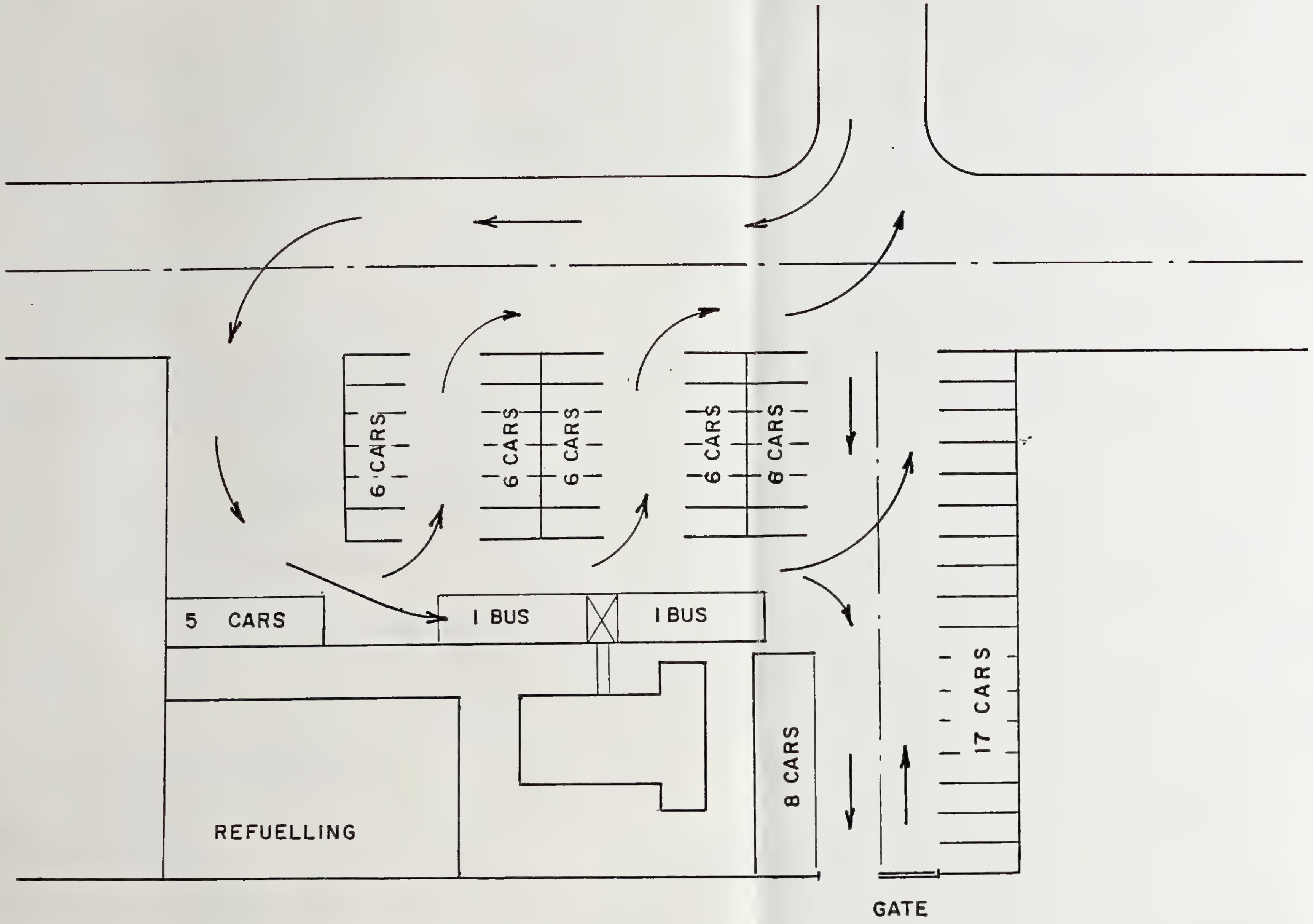
An environmental assessment has been undertaken of possible airport upgrading projects. The environmental impact of these projects has been assessed and the Transport Canada forms presented in Appendix D.

The environmental setting of the Hinton/Jasper Airfield is one of considerable landscape modification by man, preeminently expressed in the widespread removal and disruption of the forest and associated ground cover occasioned by commercial logging operations. Modification also has been expressed in a network of logging trails, temporary work pads and the like. Potentially valuable habitats, including permanent wetlands, have diminshed in value because of destruction of edge habitat and ground cover generally.

The environmental assessment has been directed towards impacts from airside and landside upgrading. On the airside, the possibility of runway extension is addressed. On the landside, roadway and parking lot pavement are addressed.

These improvements are likely to impose neither short- nor long-term negative impacts on the environment in the immediate vicinity of the airfield; likewise, broader areal impacts are expected to be minimal.

Accordingly mitigation requirements associated with proposed upgrading will not be necessary.



DATE	REVISIONS	APP

JASPER-HINTON AIRPORT
PLANNING STUDY

PARKING LAYOUT

Reid Crowther
Reid Crowther & Partners Ltd.
☐ Consulting Engineers

SCALE 1:500
DATE
DES DWN
CKD APP
PROJ NO
DWG NO
EXHIBIT 5

An opportunity may exist to enhance the environment in the general vicinity of the airfield through judicious restoration of wetland areas lying generally parallel to and on either side of the runway. Habitat enhancement potentially could occur without necessarily imposing a bird hazard on aircraft movements, but such potential for enhancement would require site evaluation of the ground conditions.

SUMMARY AND PROJECT PRIORIZATION

The priority of recommended projects is summarized as follows:

1. Paving program for the airport access road and parking lot.

   Estimated Cost $825,000

2. Airside plug-ins in the aircraft tie-down area.

   Estimated Cost $15,000

3. Terminal expansion Estimated Cost $170,000

Other projects to be assessed in the future are:

1. Airside campground facilities.

2. Restoration of airport area wetland areas.

APPENDIX A - BUS COMPANY LETTER

BREWSTER
TRANSPORTATION & TOURS
A GREYHOUND COMPANY

February 24, 1990

Mr. Harvey Olsen
7410 Blackfoot Trail S.E.
Calgary, Alberta
T2H 1M5

Dear Mr. Olsen,

This letter will confirm that Brewster Transportation & Tours would consider operating ground transportation between Jasper and the Jasper/Hinton Airport in the event an air carrier commenced scheduled service into this facility.

We would consider operating either on a charter or scheduled basis, depending on requirements and aircraft capacity.

Yours very truly,

BREWSTER TRANSPORTATION & TOURS

Mel Billings
Jasper Regional Manager

c.c. Terry Gainer
Cindy Beland

CORPORATE OFFICE:
100 Gopher Street
Post Office Box 1140
Banff, Alberta T0L 0C0
Telephone: (403) 762-6700
Fax: (403) 762-6750

CALGARY:
808 Centre Street South
Calgary, Alberta T2G 5J2
Telephone: (403) 221-8242
Fax: (403) 221-8250

JASPER
Post Office Box 400
Jasper, Alberta T0E 1E0
Telephone: (403) 852-3332
Fax: (403) 852-3211

APPENDIX B - PRELIMINARY GEOTECHNICAL EVALUATION

THURBER CONSULTANTS LTD.
SUITE 110, 7710 - 5 STREET S.E., CALGARY, ALBERTA T2H 2L9
PHONE (403) 253-9217 FAX (403) 252-8159

December 21, 1989

FILE: 17-357-78

Reid Crowther and Partners Ltd.
7410 Blackfoot Trail S.E.
Calgary, Alberta
T2H 1M5

Attention: Mr. H.E. Olsen, P.Eng.

RE: EXTENSION OF THE JASPER-HINTON RUNWAY
PRELIMINARY GEOTECHNICAL EVALUATION

Dear Sir:

This letter presents a preliminary geotechnical evaluation in connection with the proposed extension of the Jasper-Hinton runway.

The existing paved runway is about 1300 m long. It will be extended to an undetermined length, which will not exceed about 3000 m. It is most likely that the runway extension will be constructed at the northeast end of the existing runway, since less fill would be required, as compared to the southeast end.

The geotechnical evaluation is based on an examination of a drawing entitled 'Plan Showing Jasper Hinton Airport', prepared by Alberta Transportation. The date and drawing number were not legible on the copy of the plan provided. The drawing shows a plan and profile of the runway, together with test hole information along the runway. In addition, the following air photographs were examined:

Date	Scale	Line	Photos
Sept. 30, 1982	1:30,000	AS2636	39 to 42
May 16, 1985	1:6000	AS3116	96 to 103

1.0 Site Conditions

An airphoto mosaic of the airport and surrounding area is presented on Figure 1, attached.

The airport is located about 15 km southeast of the Town of Hinton, Alberta. The airport is located about 3.5 km northeast of Highway 16 and 3.5 km southeast of the Athabasca River.

The topography in the vicinity of the airport is gently rolling, with slopes in the immediate vicinity of the airport ranging up to about 5 percent. A ridge is located about 1.5 km northeast from the northeast end of the existing runway. This ridge may intersect the approach path if the runway is lengthened.

The area is underlain at relatively shallow depth by sandstone and shale bedrock of the Brazeau Formation. Depths to bedrock in the vicinity of the airport were found to range from about 0.3 to more than 3 m below ground surface. No information was available with respect to the properties of the bedrock encountered in the test holes.

As indicated on Figure 1, the area in the vicinity of the airport appears to be fairly well drained. A number of poorly drained areas are present, however, adjacent to the runway, as shown on the mosaic.

The bedrock was found to be overlain by silty gravel (glaciofluvial outwash and/or till) and sand over the northeast half of the runway. Silty clay (possibly till) overlain by sand was present over the southwest half of the runway.

A number of borrow pits are evident in the vicinity of the existing runway. These pits were most likely used for common fill, and possibly granular fill, during runway construction.

2.0 Geotechnical Evaluation

Test holes would have to be drilled along the proposed centreline of the extension at the northeast end of the runway, in order to confirm subsurface conditions.

The available information indicates that subsurface conditions at the northeast end of the runway are reasonably good, from a geotechnical point of view. The subsurface soils are expected to be generally incompressible. Several poorly drained areas are located near the northeast end of the runway as shown on Figure 1. It is expected that peat and compressible silts and clays will be present in these areas, to depths which are most likely about 2 m in thickness, but could range up to 4 m or more in depth. These deposits are not of concern, however, since they are not present below the area for the proposed runway extension.

Common fill for the runway extension could most likely be obtained from borrow pits established in the area. A series of test pits would have to be excavated in order to establish the quantity and quality of the available borrow materials. The outwash deposit located northeast of the terminal building (see Figure 1) may contain granular material suitable for runway construction. Sand dunes are present at the southeast end of the runway, which could be used for subgrade construction. However, the sand will be highly susceptible to wind erosion. It would be necessary to cover the exposed sand with gravel or clay (in the borrow pit and in the fills) in order to prevent wind erosion.

It should be noted that the extension to the runway will require fill depths ranging up to about 15 m in depth. Such fills will settle 50 to 200 mm over a period of 1 or 2 years, even if the material is carefully selected, placed and compacted. Surface settlements may affect the operation of the runway and therefore the settlement of the fill should be considered in establishing the project schedule. It would be desirable to place the fill 1 or 2 years in advance of paving. Alternatively, a thin initial pavement section could be used for the first year or so of operation, with a pavement overlay placed at a later date.

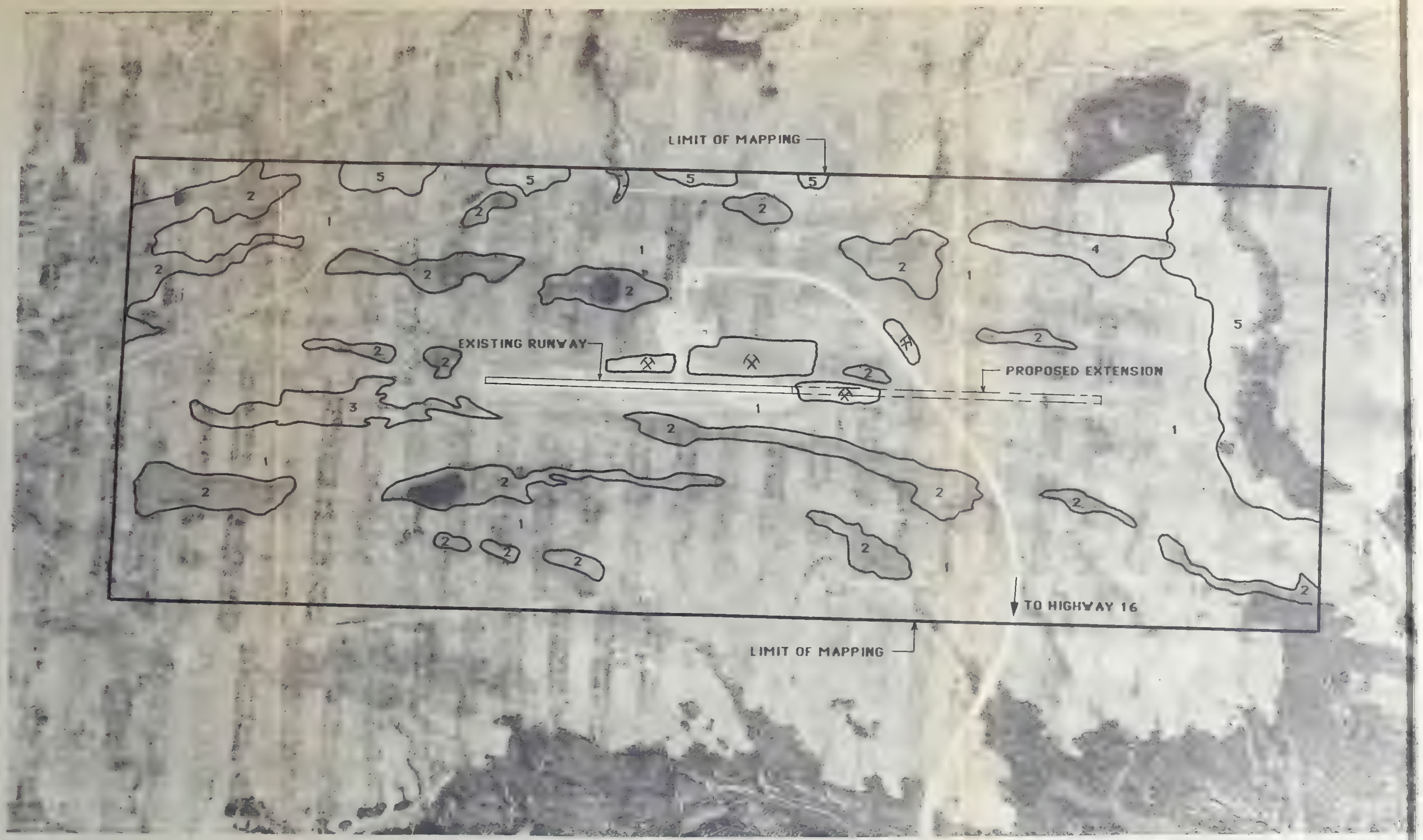
3.0 Closure

We trust the foregoing comments meet your present requirements. Please do not hesitate to contact us if you have questions or would like to discuss the geotechnical aspects of the project in further detail.

Yours truly,
Thurber Consultants Ltd.
N. Hernadi, P.Eng.
Review Engineer

L.B. Smith, P.Eng.
Project Engineer

LBS\es
A209-1



SOIL UNIT		DESCRIPTION
1	Moraine Veneer	Thin glacial till overlying bedrock the till is variable but generally consists of silty clay Often is discontinuously overlain by shallow eolian dune sand and/or outwash gravel
2	Organic Fen and Veneer	Drained depressions containing peat and organic rich silt and clay; expected to be less than 2 m in thickness but could be deeper in some locations
3	Sand Dunes.	Wind blown sand and silt
4	Outwash	Sand, some gravel and silt
5	Bedrock	Shale and sandstone with discontinuous till or sand veneer

⚒ BORROW PITS

┬─┬ ESCARPMENT

REID CROWTHER AND PARTNERS LTD.

TERRAIN ANALYSIS

RUNWAY EXTENSION
HINTON, ALBERTA

THURBER CONSULTANTS LTD., Geotechnical Engineers

DRAWN IGJ/LBS
DATE DEC [illegible]
1:15 000 approx.
1

APPENDIX C - COST ESTIMATES

APPENDIX C

RUNWAY EXTENSION ESTIMATES

Common Excavation - \$2 - \$3.50 up to 4 km haul use \$4.00 (AT & U)

Blasting Bedrock - \$5.50 - \$7.50 additional to Common Excavation (small job) (Hinton area contractor)
- \$2.50 - \$3.50 additonal to Common Excavation (large job) (Calgary/Edmonton contractor) use \$4.00

Excavation of the hill is assumed to be 50% bedrock and 50% till.

Runway up to 8000' pavement (overlay existing and new pavement on extension)	\$30/m^2	(T.C.)
Runway up to 1200' pavement (all new pavement)	\$150/m^2	(T.C.)
Air terminal cost	\$1400/m^2	(T.C.)
Small terminal renovations	\$1600/m^2	(RCPL)
Asphalt Cement Pavement	\$35/t	(AT&U)
Gravel Base Course	\$10/t	(AT&U)
Road Common Ex.	\$2/m^3	

6000' RUNAWY (150' WIDE)

1,300,000 m^3 fill		
50% blasted	650,000 @ \$4.00 =	2,600,000
	1,300,000 @ \$4.00 =	5,200,000
		7,800,000
Runway Improvement	$\frac{900,000}{10.28}$ sq.ft. @ \$30	2,625,000
		10,425,000
Engineering (+15%)		1,563,750
		\$11,988,750
	Say	\$12,000,000

8000' RUNWAY (150' WIDE)

2,100,000 m^3 fill		
50% blasted	1,050,000 @ \$4.00 =	4,200,000
	2,100,000 @ \$4.00 =	8,400,000
		12,600,000

Runway Improvement	$\frac{1,200,000}{10.28}$ @ \$30		3,502,000
			16,102,000
Engineering (+ 15%)			2,415,300
			18,517,300
		Say	\$18,500,000

10,000' RUNWAY (150' WIDE)

2,200,000 m^3 fill
3,000,000 m^3 excavation required.

50% blasted	1,500,000 @ \$4.00		6,000,000
	3,000,000 @ \$4.00		12,000,000
			18,000,000
New Runway	$\frac{1,500,000}{10.25}$ @ \$150		21,890,000
			39,890,000
Engineering (+15%)			5,983,500
			45,873,500
		Say	\$46,000,000

12,000' RUNWAY (150' WIDE)

Fill			18,000,000
New Runway	$\frac{1,800,000}{10.28}$ x 150		26,250,000
			44,250,000
Engineering (+15%)			6,375,000
			50,625,000
		Say	\$50,000,000

New Terminal STEP 4	665 m^2 @ \$1400/m^2		931,000
	Engineering (15%)		139,650
			1,070,650
		Say	\$1,100,000
STEP 4.5	850 m^2 @ 1400/m^2		1,190,000
	Engineering (+15%)		178,500
			1,368,500
		Say	\$1,375,000

ACCESS ROAD (9 M)

100 mm ACP @ $35/t =		417,375	
100 mm GBC @ $10/t =		119,250	
10,000 m^3 common @ $2 =		20,000	
		556,625	
Engineering and Contingency +25%		139,155	
		685,770	
	Say	$700,000	
Parking Lot			
150 mm ACP @ $35/t =		48,700	
100 mm GBC @ $10/t =		10,000	
Markings, plugins, lighting =		40,000	
		98,700	
Engineering and Contingencies 25%		24,550	
		123,250	
	Say	$125,000	
			$825,000

AIRSIDE PLUG-INS

Lump Sum		$15,000

SMALL TERMINAL RENOVATION

90 m^2 @ $1600/$m^2$		$144,000
Engineering (45%)		21,600
		$166,600
	Say	$170,000

APPENDIX D - ENVIRONMENTAL ASSESSMENT

SCACE & ASSOCIATES LTD.
P.O. BOX 7156
POSTAL STATION 'E'
CALGARY, ALBERTA
T3C 3M1
(403) 246-8303

December 23/89

Reid Crowther & Partners Ltd.,
7410 Blackfoot Trail S.E.,
CALGARY. Alberta.
T2H 1M5

attention: Harvey E. Olsen P.Eng.
Manager, Transportation Division

Dear Mr. Olsen,

re: Hinton-Jasper Airfield Expansion
Environmental Impact Assessment

Attached please find a completed EIA statement associated with proposed upgrading to infrastructure at the above-noted airfield. The EIA has been prepared on the basis of review of NTS maps, high and low-level air photos, an examination of geotechnical and soils information, and a library search.

The environmental setting of the Hinton/Jasper Airfield is one of considerable landscape modification by man, preeminently expressed in the widespread removal and disruption of the forest and associated ground cover occasioned by commercial logging operations. Modification also has been expressed in a network of logging trails, temporary work pads and the like. Potentially valuable habitats, including permanent wetlands, have diminished in value because of destruction of edge habitat and ground cover generally.

The airfield upgrading proposal calls for runway extension to a total length not to exceed 3000m, paving of the access road and parking lot, and possibly minor realignment of the access road to accommodate runway extension. Summer-time construction is envisaged, and a modest increase in air and associated ground traffic is anticipated after improvements are completed.

These improvements are likely to impose neither short- nor long-term negative impacts on the environment in the immediate vicinity of the airfield; likewise, broader areal impacts are expected to be minimal. Accordingly mitigation requirements associated with proposed upgrading will not be necessary.

An opportunity may exist to enhance the environment in the general vicinity of the airfield through judicious restoration of wetland areas lying generally parallel to and on either side of the runway. Habitat enhancement potentially could occur without necessarily imposing a bird hazard on aircraft movements, but such potential for enhancement would require site evaluation of the ground conditions.

Yours sincerely,

Robert C. Scace Ph.D.
attach.

COMPONENT: terrestrial mammals [✓ y] n u

NAME: moose, deer

ATTRIBUTES:
special status y [✓ n] u
pollutant-sensitive y [✓ n] u

LINKAGES:
terr mammal habitat [✓ y] n u

Athabasca Riv. valley -------------------- --------------------

-------------------- -------------------- --------------------

COMPONENT: terrestrial birds y [✓ n] u

NAME: --------------------

ATTRIBUTES:
special status y [✓ n] u
pollutant-sensitive y [✓ n] u

LINKAGES:
terr bird habitat y [✓ n] u

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-------------------- -------------------- --------------------

COMPONENT: reptiles y [✓ n] u

NAME: --------------------

ATTRIBUTES:
special status y [✓ n] u
pollutant-sensitive y [✓ n] u

LINKAGES:
reptile habitat y [✓ n] u

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COMPONENT: arthropods y [✓ n] u

NAME:

ATTRIBUTES:
special status y [✓ n] u
pollutant-sensitive y [✓ n] u

LINKAGES:

COMPONENT: terr mammal habitat [✓ y] n u

NAME:

ATTRIBUTES:
critical y [✓ n] u

LINKAGES:
lakes [✓ y] n u

Kinky, Peach, Wildhorse, Kia Nea, unnamed ponds

rivers [✓ y] n u

Athabasca

streams y [✓ n] u

reservoirs y [✓ n] u

estuaries y [✓ n] u

[illegible]

____________________ ____________________ ____________________

____________________ ____________________ ____________________

oceans y [✓ n] u

____________________ ____________________ ____________________

____________________ ____________________ ____________________

COMPONENT: terr bird habitat y [✓ n] u

NAME: ____________________

ATTRIBUTES:
critical y [✓ n] u

LINKAGES:
lakes y [✓ n] u

____________________ ____________________ ____________________

____________________ ____________________ ____________________

rivers y [✓ n] u

____________________ ____________________ ____________________

____________________ ____________________ ____________________

streams y [✓ n] u

____________________ ____________________ ____________________

____________________ ____________________ ____________________

reservoirs y [✓ n] u

____________________ ____________________ ____________________

____________________ ____________________ ____________________

estuaries y [✓ n] u

____________________ ____________________ ____________________

[illegible]

oceans y [✓ n] u

COMPONENT. reptile habitat y [✓ n] u

NAME. ____________________

ATTRIBUTES.
critical y [✓ n] u

LINKAGES.
lakes y [✓ n] u

rivers y [✓ n] u

streams y [✓ n] u

reservoirs y [✓ n] u

estuaries y [✓ n] u

```
    estuaries y [✓ n] u

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      --------------------   --------------------   --------------------

    oceans y [✓ n] u

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COMPONENT: trees [✓ y] n u

NAME. --------------------

ATTRIBUTES.
    special status              y [✓ n] u
    pollutant-sensitive         y [✓ n] u

LINKAGES:
    atmosphere y [✓ n] u

      --------------------   --------------------   --------------------

      --------------------   --------------------   --------------------


COMPONENT: shrubs  y [✓ n] u

NAME. --------------------

ATTRIBUTES.
    special status              y [✓ n] u
    pollutant-sensitive         y [✓ n] u

LINKAGES
    atmosphere y [✓ n] u

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      --------------------   --------------------   --------------------
```

COMPONENT: grasses y [✓ n] u

NAME: --------------------

ATTRIBUTES:
special status y [✓ n] u
pollutant-sensitive y [✓ n] u

LINKAGES:
atmosphere y n u

COMPONENT: crops y [✓ n] u

NAME. --------------------

ATTRIBUTES:
special status y [✓ n] u
pollutant-sensitive y [✓ n] u

LINKAGES:
atmosphere y n u

COMPONENT: aquatic mammals y [✓ n] u

NAME: --------------------

ATTRIBUTES:
special status y [✓ n] u
pollutant-sensitive y [✓ n] u
acid-sensitive y [✓ n] u

LINKAGES:
aquatic mammal habitat y [✓ n] u

COMPONENT: grasses y [✓ n] u

NAME: ____________________

ATTRIBUTES:
special status y [✓ n] u
pollutant-sensitive y [✓ n] u

LINKAGES:
atmosphere y n u

____________________ ____________________ ____________________

____________________ ____________________ ____________________

COMPONENT: crops y [✓ n] u

NAME: ____________________

ATTRIBUTES:
special status y [✓ n] u
pollutant-sensitive y [✓ n] u

LINKAGES:
atmosphere y [✓ n] u

____________________ ____________________ ____________________

____________________ ____________________

COMPONENT: aquatic mammals y [✓ n] u

NAME: ____________________

ATTRIBUTES:
special status y [✓ n] u
pollutant-sensitive y [✓ n] u
acid-sensitive y [✓ n] u

LINKAGES:
aquatic mammal habitat y [✓ n] u

____________________ ____________________ ____________________

lakes y [✓ n] u

rivers y [✓ n] u

streams y [✓ n] u

reservoirs y [✓ n] u

estuaries y [✓ n] u

oceans y [✓ n] u

COMPONENT: aquatic birds [✓ y] n u

NAME: waterfowl - migrant

ATTRIBUTES

special status y [✓ n] u

pollutant-sensitive y [✓ n] u

acid-sensitive y [✓ n] u

LINKAGES:

aquatic bird habitat [✓ y] n u

lakes [✓ y] n u

rivers y [✓ n] u

streams y [✓ n] u

reservoirs y [✓ n] u

estuaries y [✓ n] u

oceans y [✓ n] u

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COMPONENT: fish y [✓ n] u

NAME: --------------------

ATTRIBUTES:
special status y [✓ n] u
pollutant-sensitive y [✓ n] u
acid-sensitive y [✓ n] u

LINKAGES:
fish habitat y [✓ n] u

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-------------------- -------------------- --------------------

lakes y [✓ n] u

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-------------------- -------------------- --------------------

rivers y [✓ n] u

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-------------------- -------------------- --------------------

streams y [✓ n] u

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-------------------- -------------------- --------------------

reservoirs y [✓ n] u

-------------------- -------------------- --------------------

-------------------- -------------------- --------------------

estuaries y [✓ n] u

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-------------------- -------------------- --------------------

oceans y [✓ n] u

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COMPONENT. shell/molluscs y [✓ n] u

NAME: --------------------

ATTRIBUTES:
special status y [✓ n] u
pollutant-sensitive y [✓ n] u
acid-sensitive y [✓ n] u

LINKAGES:
shell/molluscs habitat y [✓ n] u

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-------------------- -------------------- --------------------

lakes y [✓ n] u

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rivers y [✓ n] u

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-------------------- -------------------- --------------------

streams y [✓ n] u

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-------------------- -------------------- --------------------

reservoirs y [✓ n] u

-------------------- -------------------- --------------------

reservoirs y [✓ n] u

-------------------- -------------------- --------------------

-------------------- -------------------- --------------------

estuaries y [✓ n] u

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-------------------- -------------------- --------------------

oceans y [✓ n] u

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-------------------- -------------------- --------------------

COMPONENT: amphibians y [✓ n] u

NAME: --------------------

ATTRIBUTES:
special status y [✓ n] u
pollutant-sensitive y [✓ n] u
acid-sensitive y [✓ n] u

LINKAGES:
amphibian habitat y [✓ n] u

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lakes y [✓ n] u

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-------------------- -------------------- --------------------

rivers y [✓ n] u

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-------------------- -------------------- --------------------

streams y [✓ n] u

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-------------------- -------------------- --------------------

reservoirs y [✓ n] u

-------------------- -------------------- --------------------

-------------------- -------------------- --------------------

estuaries y [✓ n] u

-------------------- -------------------- --------------------

-------------------- -------------------- --------------------

oceans y [✓ n] u

-------------------- -------------------- --------------------

-------------------- -------------------- --------------------

COMPONENT: benthos y [✓ n] u

NAME: --------------------

ATTRIBUTES:

special status	y [✓ n] u
pollutant-sensitive	y [✓ n] u
acid-sensitive	y [✓ n] u

LINKAGES:
benthic habitat y [✓ n] u

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-------------------- -------------------- --------------------

lakes y [✓ n] u

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-------------------- -------------------- --------------------

streams y [✓ n] u

-------------------- -------------------- --------------------

-------------------- -------------------- --------------------

reservoirs y [✓ n] u

-------------------- -------------------- --------------------

-------------------- -------------------- --------------------

estuaries y [✓ n] u

-------------------- -------------------- --------------------

-------------------- -------------------- --------------------

oceans y [✓ n] u

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-------------------- -------------------- --------------------

COMPONENT: benthos y [✓ n] u

NAME: --------------------

ATTRIBUTES:

special status	y [✓ n] u
pollutant-sensitive	y [✓ n] u
acid-sensitive	y [✓ n] u

LINKAGES:

benthic habitat y [✓ n] u

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-------------------- -------------------- --------------------

lakes y [✓ n] u

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rivers y [✓ n] u

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--------------------   --------------------   --------------------

streams y [✓ n] u

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reservoirs y [✓ n] u

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estuaries y [✓ n] u

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oceans y [✓ n] u

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COMPONENT: aquatic mammal habitat y [✓ n] u

NAME: --------------------

ATTRIBUTES:
critical y [✓ n] u

LINKAGES:
lakes y [✓ n] u

lakes y [✓ n] u

rivers y [✓ n] u

streams y [✓ n] u

reservoirs y [✓ n] u

estuaries y [✓ n] u

oceans y [✓ n] u

COMPONENT: aquatic bird habitat y [✓ n] u

NAME: Permanent ponds/lakes

ATTRIBUTES
critical y [✓ n] u

LINKAGES:
lakes [✓ y] n u

lakes [✓ y] n u

rivers [✓ y] n u

Athabasca

streams y [✓ n] u

reservoirs y [✓ n] u

estuaries y [✓ n] u

oceans y [✓ n] u

COMPONENT: fish habitat y [✓ n] u

NAME:

ATTRIBUTES
critical y [✓ n] u

LINKAGES:
lakes y n u

lakes y [✓ n] u

rivers y [✓ n] u

streams y [✓ n] u

reservoirs y [✓ n] u

estuaries y [✓ n] u

oceans y [✓ n] u

COMPONENT: shell/molluscs habitat y [✓ n] u

NAME: --------------------

ATTRIBUTES
critical y [✓ n] u

LINKAGES
lakes y n u

lakes y [✓ n] u

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rivers y [✓ n] u

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streams y [✓ n] u

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reservoirs y [✓ n] u

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estuaries y [✓ n] u

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oceans y [✓ n] u

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COMPONENT: amphibian habitat y [✓ n] u

NAME: --------------------

ATTRIBUTES:

critical y [✓ n] u

LINKAGES:

lakes y [✓ n] u

lakes y [✓ n] u

rivers y [✓ n] u

streams y [✓ n] u

reservoirs y [✓ n] u

estuaries y [✓ n] u

oceans y [✓ n] u

COMPONENT: benthic habitat y [✓ n] u

NAME. --------------------

ATTRIBUTES

critical y [✓ n] u

LINKAGES.

lakes y [✓ n] u

lakes y [✓ n] u

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rivers y [✓ n] u

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streams y [✓ n] u

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-------------------- -------------------- --------------------

reservoirs y [✓ n] u

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estuaries y [✓ n] u

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oceans y [✓ n] u

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COMPONENT: aquatic vegetation y [✓ n] u

NAME. --------------------

ATTRIBUTES
critical y [✓ n] u

LINKAGES..

COMPONENT: rivers y [✓ n] u

NAME: --------------------

ATTRIBUTES:

low flow rate	y [✓ n] u
low turbidity	y [✓ n] u
low alkalinity	y [✓ n] u
high do	y [✓ n] u
normal salinity	y [✓ n] u
low pollutant levels	y [✓ n] u

LINKAGES:

soils y [✓ n] u

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underground aquifers y [✓ n] u

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aquifer recharge areas y [✓ n] u

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COMPONENT: streams y [✓ n] u

NAME. --------------------

ATTRIBUTES.

low flow rate	y [✓ n] u
low turbidity	y [✓ n] u
low alkalinity	y [✓ n] u
high do	y [✓ n] u
normal salinity	y [✓ n] u
low pollutant levels	y [✓ n] u

LINKAGES:

soils y [✓ n] u

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underground aquifers y [✓ n] u

aquifer recharge areas y [✓ n] u

COMPONENT: lakes [✓ y] n u

NAME: unnamed ponds

ATTRIBUTES:

low turbidity	y [✓ n] u
low nutrients	y [✓ n] u
low flushing rate	y [✓ n] u
low alkalinity	y [✓ n] u
high do	y [✓ n] u
normal salinity	y [✓ n] u
low pollutant levels	y [✓ n] u

LINKAGES:

soils y [✓ n] u

underground aquifers y [✓ n] u

aquifer recharge areas y n [✓ u]

COMPONENT: reservoirs y [✓ n] u

NAME: --------------------

ATTRIBUTES:

low turbidity y [✓ n] u
low nutrients y [✓ n] u
low flushing rate y [✓ n] u
low alkalinity y [✓ n] u
high do y [✓ n] u
normal salinity y [✓ n] u
low pollutant levels y [✓ n] u

LINKAGES:

soils y [✓ n] u

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underground aquifers y [✓ n] u

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____________________ ____________________ ____________________

aquifer recharge areas y [✓ n] u

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COMPONENT: estuaries y [✓ n] u

NAME: --------------------

ATTRIBUTES:

low flushing rate y [✓ n] u
normal salinity y [✓ n] u
low pollutant levels y [✓ n] u

LINKAGES:

soils y [✓ n] u

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COMPONENT: oceans y [✓ n] u

NAME: --------------------

ATTRIBUTES:

low flushing rate	y [✓ n] u
normal salinity	y [✓ n] u
low pollutant levels	y [✓ n] u

LINKAGES:

soils y [✓ n] u

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COMPONENT: aquatic environment y [✓ n] u

NAME: --------------------

ATTRIBUTES.

LINKAGES:

COMPONENT: underground aquifers y [✓ n] u

NAME: --------------------

ATTRIBUTES:

normal salinity	y [✓ n] u
low pollutant levels	y [✓ n] u
slow recharge	y [✓ n] u
shallow water table	y [✓ n] u
low temperature	y [✓ n] u

LINKAGES:

soils y n u

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aquifer recharge areas y [✓ n] u

aquifer recharge areas y [✓ n] u

COMPONENT: aquifer recharge areas y [✓ n] u

NAME: --------------------

ATTRIBUTES:
high infiltration rate y [✓ n] u

LINKAGES:
soils y [✓ n] u

COMPONENT: permafrost/ground ice y [✓ n] u

NAME: --------------------

ATTRIBUTES.
special status y [✓ n] u

LINKAGES:

COMPONENT: gravel/sand deposits [✓ y] n u

NAME: sand dunes

ATTRIBUTES:
special status y [✓ n] u

LINKAGES:

COMPONENT: wetlands [✓ y] n u

NAME: Unnamed ponds

ATTRIBUTES:
special status y [✓ n] u

LINKAGES: potential to nearby small lakes, Athabasca River

COMPONENT: soils y [✓ n] u

NAME:

ATTRIBUTES:
high akalinity y [✓ n] u
high permeability y [✓ n] u
contaminated y [✓ n] u
sensitive y [✓ n] u
acid-bearing y [✓ n] u
normal salinity y [✓ n] u
low pollutant levels y [✓ n] u
erodible quality y [✓ n] u

LINKAGES:

COMPONENT: atmosphere [✓ y] n u

NAME:

ATTRIBUTES:
stable conditions y n [✓ u]
cold temperatures [✓ y] n u
ambient noise < 30 nef y [✓ n] u
pollutants within std [✓ y] n u
low metal content [✓ y] n u
low dust content y [✓ n] u

LINKAGES:
soils [✓ y] n u

wind blown dust from sand dunes

COMPONENT: native res harvestng y [✓ n] u

NAME:

ATTRIBUTES:

LINKAGES.
fish y [✓ n] u

shell/molluscs y n u

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shell/mollusccs y [✓ n] u

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terrestrial birds y [✓ n] u

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aquatic birds y [✓ n] u

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terrestrial mammals y [✓ n] u

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aquatic mammals y [✓ n] u

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COMPONENT: commcl res harvestng y [✓ n] u

NAME. --------------------

ATTRIBUTES:

LINKAGES:
fish y [✓ n] u

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shell/molluscs y [✓ n] u

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terrestrial birds y [✓ n] u

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aquatic birds y [✓ n] u

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terrestrial mammals y [✓ n] u

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aquatic mammals y [✓ n] u

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COMPONENT: hunting y [✓ n] u

NAME: --------------------

ATTRIBUTES:

LINKAGES:

terrestrial birds y [✓ n] u

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aquatic birds y n u

aquatic birds y [✓ n] u

terrestrial mammals y [✓ n] u

COMPONENT: fishing y [✓ n] u

NAME: ____________________

ATTRIBUTES:

LINKAGES:
fish y [✓ n] u

COMPONENT: birdwatching y [✓ n] u

NAME: ____________________

ATTRIBUTES:

LINKAGES:
terrestrial birds y [✓ n] u

aquatic birds y [✓ n] u

COMPONENT: boating y [✓ n] u

NAME.

ATTRIBUTES:

LINKAGES:

lakes y [✓ n] u

rivers y [✓ n] u

streams y [✓ n] u

reservoirs y [✓ n] u

estuaries y [✓ n] u

oceans y [✓ n] u

COMPONENT: swimming y [✓ n] u

NAME. --------------------

ATTRIBUTES.

LINKAGES.

lakes y [✓ n] u

rivers y [✓ n] u

streams y [✓ n] u

reservoirs y [✓ n] u

estuaries y [✓ n] u

oceans y [✓ n] u

COMPONENT: cottaging y [✓ n] u

NAME. --------------------

ATTRIBUTES:

LINKAGES.

lakes y [✓ n] u

rivers y [✓ n] u

streams y [✓ n] u

reservoirs y [✓ n] u

estuaries y [✓ n] u

oceans y [✓ n] u

COMPONENT: firefighting y [✓ n] u

NAME: --------------------

ATTRIBUTES:

LINKAGES:

COMPONENT: police y [✓ n] u

NAME: --------------------

ATTRIBUTES:

LINKAGES:

COMPONENT: public transportation y [✓ n] u

NAME: --------------------

ATTRIBUTES:

LINKAGES:

COMPONENT: roadways [✓ y] n u

NAME: Highway 16 and access Road

ATTRIBUTES.

LINKAGES: ground transportation link

COMPONENT: drinking water [✓ y] n u

NAME. --------------------

ATTRIBUTES:

LINKAGES:
lakes y [✓ n] u

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rivers y [✓ n] u

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streams y [✓ n] u

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-------------------- -------------------- --------------------

reservoirs y [✓ n] u

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underground aquifers [✓ y] n u

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aquifer recharge areas y [✓ n] u

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COMPONENT: irrigation water y [✓ n] u

NAME. --------------------

ATTRIBUTES:

LINKAGES:
lakes y [✓ n] u

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rivers y n u

rivers y [✓ n] u

streams y [✓ n] u

reservoirs y [✓ n] u

underground aquifers y [✓ n] u

aquifer recharge areas y [✓ n] u

COMPONENT: sanitary sewers y [✓ n] u

NAME. --------------------

ATTRIBUTES:

LINKAGES:

COMPONENT: storm sewers y [✓ n] u

NAME. --------------------

ATTRIBUTES

LINKAGES:

COMPONENT: power lines y [✓ n] u

NAME: ____________________

ATTRIBUTES:

LINKAGES:

COMPONENT: gaslines y [✓ n] u

NAME. ____________________

ATTRIBUTES:

LINKAGES:

COMPONENT: agricultural land use y [✓ n] u

NAME: ____________________

ATTRIBUTES:

future y [✓ n] u
offsite y [✓ n] u

LINKAGES:

COMPONENT: animal refuge land use y [✓ n] u

NAME: ____________________

ATTRIBUTES:

future y [✓ n] u
offsite y [✓ n] u

LINKAGES:

COMPONENT: archaeological sites y [✓ n] u

NAME: ____________________

ATTRIBUTES

future y [✓ n] u
offsite y [✓ n] u

LINKAGES:

LINKAGES:

COMPONENT: commercial land use y n u

NAME: Commercial Logging

ATTRIBUTES:
future [✓ y] n u
offsite [✓ y] n u

LINKAGES:

COMPONENT: defense land use y [✓ n] u

NAME: --------------------

ATTRIBUTES:
future y [✓ n] u
offsite y [✓ n] u

LINKAGES:

COMPONENT: historical sites y [✓ n] u

NAME: --------------------

ATTRIBUTES:
future y [✓ n] u
offsite y [✓ n] u

LINKAGES:

COMPONENT: industrial land use y [✓ n] u

NAME: --------------------

ATTRIBUTES:
future y [✓ n] u
offsite y [✓ n] u

LINKAGES:

COMPONENT: native lands y [✓ n] u

NAME --------------------

ATTRIBUTES:
future y [✓ n] u
offsite y [✓ n] u

LINKAGES

COMPONENT: parks land use y [✓ n] u

NAME: --------------------

future y [✓ n] u
offsite y [✓ n] u

LINKAGES:

COMPONENT: recreational land use y n [✓ u]

NAME: --------------------

ATTRIBUTES:
future y n [✓ u]
offsite y n [✓ u]

LINKAGES:

COMPONENT: residential land use y [✓ n] u

NAME: --------------------

ATTRIBUTES:
future y [✓ n] u
offsite y [✓ n] u

LINKAGES:

COMPONENT: transp/util corridors y [✓ n] u

NAME: --------------------

ATTRIBUTES:
future y [✓ n] u
offsite y [✓ n] u

LINKAGES:

COMPONENT: wilderness land use y [✓ n] u

NAME: --------------------

ATTRIBUTES:
future y [✓ n] u
offsite y [✓ n] u

LINKAGES:

COMPONENT: "open space" land use y n [✓ u]

NAME: --------------------

ATTRIBUTES:
future y n [✓ u]
offsite [✓ y] n u

LINKAGES:

COMPONENT: employment y [✓ n] u

NAME: --------------------

LINKAGES.

COMPONENT: employment y n u

NAME: ____________________

ATTRIBUTES:
long term y [✓ n] u
short term y [✓ n] u

LINKAGES:
commcl res harvestng y [✓ n] u

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native res harvestng y [✓ n] u

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____________________	____________________	____________________

COMPONENT: personal income y [✓ n] u

NAME: ____________________

ATTRIBUTES:

LINKAGES:
commcl res harvestng y [✓ n] u

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native res harvestng y [✓ n] u

____________________	____________________	____________________
____________________	____________________	____________________

COMPONENT: reg. econ. activity [✓ y] n u

NAME: facility upgrading, related services

ATTRIBUTES:

LINKAGES: minor service roads for airfield traffic

COMPONENT: adjacent landowners y [✓ n] u

NAME: ____________________

ATTRIBUTES:

LINKAGES:

COMPONENT: airline passengers y [✓ n] u

NAME: ____________________

ATTRIBUTES:

LINKAGES:

COMPONENT: airport workers y [✓ n] u

NAME: ____________________

ATTRIBUTES:

LINKAGES:

COMPONENT: commercial harvesters y [✓ n] u

NAME: ____________________

ATTRIBUTES:

LINKAGES:

COMPONENT: local residents y [✓ n] u

NAME: ____________________

ATTRIBUTES:

LINKAGES:

COMPONENT: native harvesters y [✓ n] u

COMPONENT: native harvesters y [✓ n] u

NAME: --------------------

ATTRIBUTES:

LINKAGES:

COMPONENT: residentl neighborhds y [✓ n] u

NAME: --------------------

ATTRIBUTES:
ambient noise < 30 nef y [✓ n] u

LINKAGES:
atmosphere y [✓ n] u

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COMPONENT: general population y [✓ n] u

NAME: --------------------

ATTRIBUTES:

LINKAGES:

N.L.C. - B.N.C.
3 3286 10208294 4